Toxic Landfills

Some Preliminary Research Findings

Introduction

The disposal of waste, human or industrial, is a rapidly growing problem for developed industrial societies. Two main technologies are currently seen to represent the 'state of the art' in toxic waste management: incineration and burial or landfill. Both methods entail substantial environmental risks. This report is concerned only with the risks created by landfill methods of handling toxic wastes.

A landfill site is usually little more than a large hole in the ground (such as a worked out quarry). If the wastes intended for the landfill are considered toxic then additional precautions are usually taken to try to contain the toxic substances within the landfill site.

There are 3 ways that environmental and health problems could arise from a toxic dump:

- through direct human contact (e.g. workers handling materials, accidents at the dump or in transit, children playing at the dump);
- leakage from the landfill into surrounding water, especially ground water;
- air-borne toxins (eg. as a result of chemical reactions, dehydration and winds).

The world's 'best practice' in toxic waste management has led to a series of measures to try to overcome these problems. Safety measures in the handling of the toxic materials have been improved, with substantial 'controls' established over the transporting of such materials. The EPA monitors the movements of most toxic materials and the managers of toxic landfills are expected to closely control the types of toxic substances that are dumped in the landfill. Serious questions have been raised about the effectiveness of the various controls, but it is not within the scope of this report to investigate these.

To prevent leakage (and 'leaching') of toxic substances into surface and ground water supplies *liners* are placed in the hole before dumping begins. The *liners* need to be completely impervious to liquids, sludges and chemical reactions, over a long period of time, if they are to be effective. The liners currently used are either plastic sheets welded or glued together ('best practice' requires the expensive, 1mm high density polyethylene or HDPE), or compacted clay linings.

Because certain toxic substances will dissolve in or react with water and form substances that could break through even HDPE liners, it becomes crucial to keep water out of toxic landfills. This is sometimes referred to as the "dry tomb" requirement. Keeping the water out is attempted through extensive drainage precautions and the placing of a *cap* over the whole site to prevent rain and run-off water getting into the dump.

The *cap* also serves to help prevent the dispersal of gaseous or air-borne substances.

The important question is, do these 'best practice' safety measures make toxic landfills environmentally safe and non-threatening to human health? Current research shows that the measures have failed to make toxic landfills safe or acceptable.

It is well understood by waste disposal engineers that the threat posed by most toxic landfills will last for thousands of years, and therefore the 'safety precautions' must similarly last for thousands of years. As will be shown, even under ideal conditions, the 'safety precautions' break down within several years, with potentially disastrous consequences.

The failure of plastic liners

Plastic liners fail to adequately contain toxic waste landfills for several reasons:

- Plastic liners, whether the state of the art HDPE liners or the inferior liners, are manufactured in a manner that ensures they are never totally impermeable. The manufacturing process for plastics always creates "defect points" in some of the long polymer chains. As time passes the plastic molecules begin to spontaneously decompose, especially at the defect points. All plastics age in this way: they become brittle, weak and break up. This process can begin within only a few years and will almost certainly be well underway within a decade. This process has been well documented by researchers like Wallace (1990) and Lee and Jones (1992).
- Besides the inherent defect points researchers have found that "pinholes" often develop during manufacturing and that seams created through joining sheets (by welding or gluing) regularly leak. According to a study by US firm Geoservices "an average of one leak per 1,000 feet of seam can be expected with reasonably good installation, adequate quality assurance, and repair of noted defects" (Geoservices, 1987, p. B-11). They calculate that with the "best demonstrated available technology" a 10-acre landfill will have a leakage rate of up to 3,650 gallons of toxic fluid per year, seriously threatening ground water quality.

Even more disturbing results are reported by Bonaparte and Gross (1990, pp. 52-83) who found that the leakage rate in the 'best practice' liners was about 20 gallons per acre per day. In a 10-acre landfill this means about 73,000 gallons of toxic fluids per year will leak into the ground water.

- The above dangers exist simply as an integral characteristic of the liners, and are not dependent on 'external' influences on the liner. But there are inevitably a series of external influences on the liner. Research has shown that many toxic substances affect plastic liners to increase their permeability and substantially increase the leakage rate of certain toxic substances (Geoservices, 1987, p. B-7). Lee and Jones (1992) cite a University of Wisconsin report published in 1991 which shows that several solvents will penetrate a 1mm thick HDPE liner in less than 2 weeks.
- In addition to the chemical activity within the landfill there is always the probability of external factors that can affect the integrity of the liner. Trees and other vegetation may grow roots which penetrate the liner, animals may burrow through the liner, general earth movements may rend the liner. A recent paper shows that there is a (generally unrecognised) risk of lightning strikes which can penetrate a liner within 10 feet of the surface (Montague, 1990). The likelihood of these kind of external effects damaging the liner are sufficiently high to expect serious leakages over a period of even one decade, let alone the many decades that the dump will continue to exist once filled.

The failure of clay liners

Clay liners have often been used as a (relatively cheap) alternative to plastic liners. These are made up of compacted clay with very low permeability rates. Research shows that they fail to prevent leakage of toxic materials:

- The study by Geoservices (1987) shows that "with compacted [clay] soil bottom liners, leakage out of the [landfill] will be large (if there is leakage through the top liner or *cap*) . . . even in [landfills] meeting current EPA design requirements". They estimate a leakage rate of 90 gallons